This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

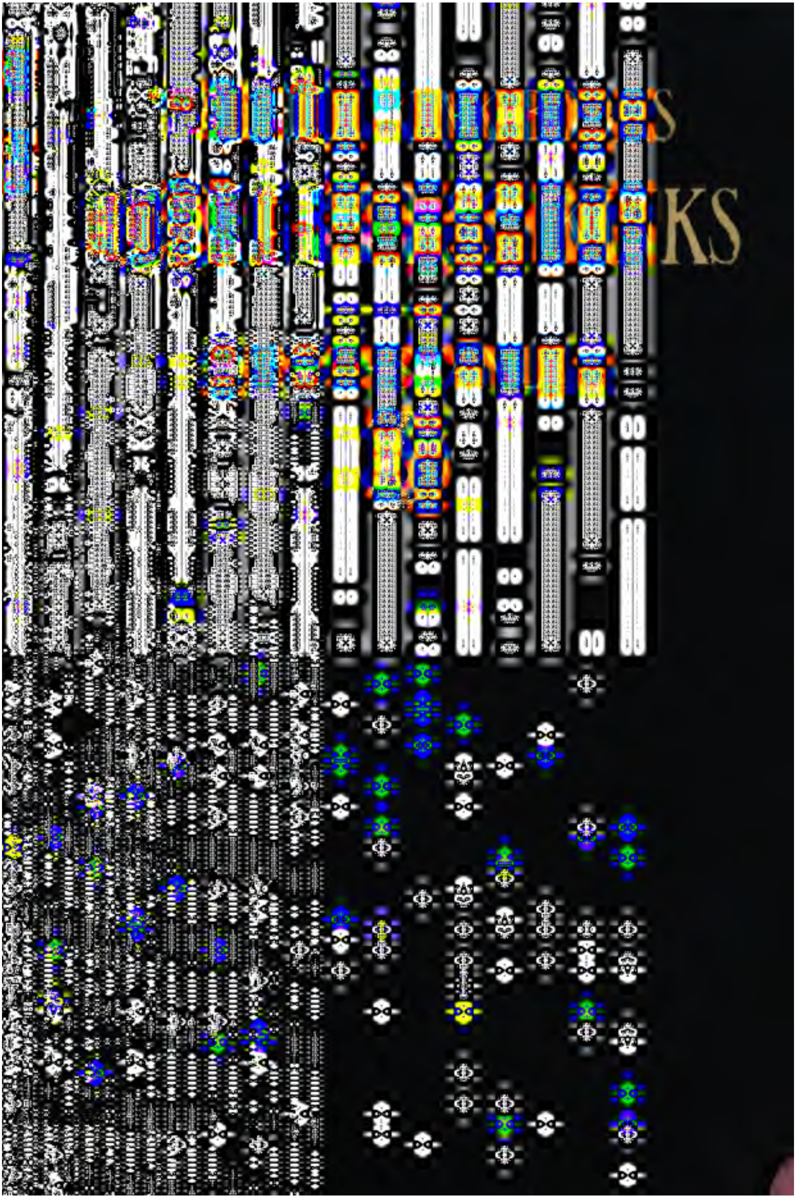
+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`



Library
of the
University of Wisconsin

THE HILL KINK BOOKS

DRILL PRESS KINKS

THE HILL KINK BOOKS

Compiled by F. H. Colvin and F. A. Stanley
Associate Editors of the *American Machinist*

Each cloth, 4x6, illustrated, 50 cents postpaid

ORDER NOW

PRESS TOOL KINKS
SCREW THREAD KINKS
PATTERNMAKING KINKS
MILLING MACHINE KINKS
REPAIR KINKS
TOOLMAKERS' KINKS
JIG AND FIXTURE KINKS
DRILL PRESS KINKS
DRAWING ROOM KINKS
SCREW MACHINE KINKS

HILL PUBLISHING COMPANY
505 PEARL ST., NEW YORK CITY
6 BOUVERIE STREET, LONDON, E.C., ENG.

American Machinist — Power — The Engineering and Mining Journal

THE HILL KINK BOOKS

DRILL PRESS KINKS

COMPILED BY

F. H. COLVIN AND F. A. STANLEY
Associate Editors of the American Machinist

1908
HILL PUBLISHING COMPANY
505 PEARL STREET, NEW YORK
6 BOUVERIE STREET, LONDON, E.C.
American Machinist — Power — The Engineering and Mining Journal

COPYRIGHT, 1908, BY THE HILL PUBLISHING COMPANY

Hill Publishing Company, New York, U.S.A.

146782
OCT 5 1910
TDN
.C72

INTRODUCTORY WORD

The kinks and other information given in this book have been selected from the experience of thoroughly practical men, as originally published in the *American Machinist*. This volume forms one of a series of this nature, aiming always to make available out-of-the-way information when most wanted. In this form the Kink Books, which can be kept in the tool-chest or the pocket, and always referred to, will, we feel, meet a demand and serve a good purpose.

F. H. Colvin.
F. A. Stanley.

New York, November, 1907.

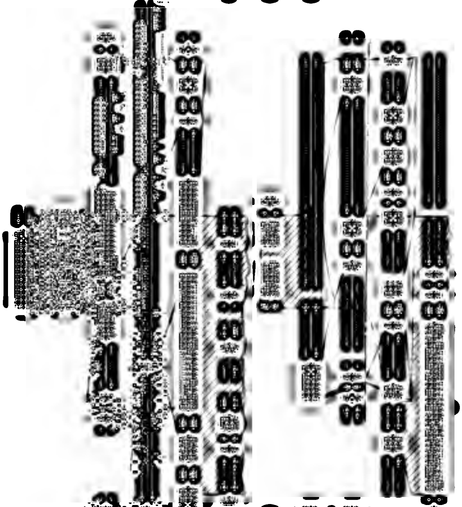
DRILL PRESS KINKS

GRINDING TWIST DRILLS FOR CUTTING AIR

Having a lot of holes to drill in which part of the drill cut air as shown in the sketches, we had some trouble in drilling the holes straight with the ordinary drill, the tendency being for the drill to shy away from the metal, as shown in Fig. 1. After grinding the drill as shown in Fig. 2, we found it as easy to drill the holes straight as if drilling a full hole.

In order to start the drill, it is necessary to use an ordinary drill, drilling just deep enough to enter the blades of the drill as ground in Fig. 2, or a jig may be used to guide the drill in starting. We have been able to do some very difficult drilling in this way, even to drilling less than a half hole, or where more than half of the drill cut air.

[illegible]



[illegible]

[illegible] ON

[illegible]

[illegible] way to [illegible] extension [illegible] h is [illegible] for [illegible]

[illegible] ary

drill rod, drilled out centrally in the bushing lathe with the drill to be lengthened. A crosswise slot *A*, Fig. 3, is either milled or filed down to the center at a slight angle with the center line of the extension. The drill is then filed off flat for a short distance at the shank, to fit the bottom of the slot in the extension, and then pressed home. The drill will then run true with the extension, and the short flat spot on the end of the drill gives a positive drive.

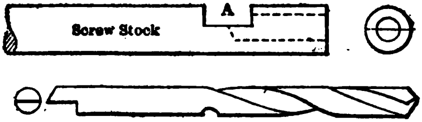


FIG. 3. — Extension Drill.

A DRILL-HOLDER

THE illustration, Fig. 4, shows a drill-holder for a tool-box, which is very handy and useful. It can be carried in the tool-box lid. It is stamped and the right drill presents itself to the eye immediately. There is no danger of the drills being displaced, even with the roughest handling

It consists of two pieces of brass or copper tubing and two pieces of flat brass which are soldered together and drilled.

After drilling, the solder joint between the two flat pieces is broken, the outside piece of tubing acting as a spring and keep the drills in position. The ⅛ pins on the ends are for small spring clips to bear upon, which hold it well back against the tool-box lid. If the holes are drilled a neat fit they will act as a gage, and it will be found that no drill except the right one will go in without appearing too easy or too tight for the hole. The sizes given are being used in some places, but they can be altered to suit other boxes.

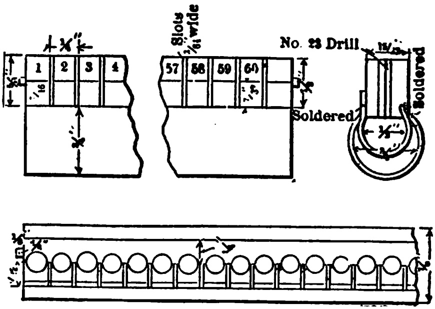


FIG. 4. — A Drill-holder.

TWO GOOD DRILLS

A VERY good spindle drill is that of the inserted cutter type with stepped cutting edges to break up the chips. This has been proved far superior to many types of drill previously used for this purpose. This drill is shown in Fig. 5.

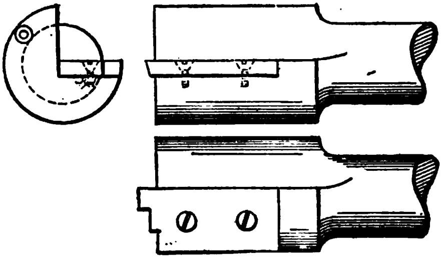


FIG. 5. — A Spindle Drill.

A drill used for finishing is shown in Fig. 6, and it will be noticed that the cutting edge is about .007 inch above the center. Naturally

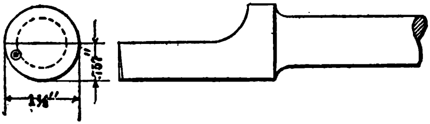


FIG. 6. — Another Spindle Drill.

the tendency in boring is to force the cutting edge down to the center, resulting in a burnishing action in the bore of the spindle. This leaves a very smooth hole.

A SPECIAL SPINDLE DRILL

FIG. 7 shows a drill for drilling long spindles. This drill is made by taking two pieces of 2⅝ x 1⅜ inch machine steel and welding about 6 inches of Styrian steel on one end of each of the pieces. When these pieces are welded on, clamp the two pieces together with lathe dogs, center and turn each end — one end to fit the turret, the other the size of the drill — then take two cast-iron collars, drive one on each end, and after removing the dogs turn the spots where they were clamped. This being done, put the end turned for the drill size in the steady-rest, and bore out this end, for about 6½ inches, the size of the hole being in proportion to the size of the drill. For instance, the drill represented is 2⅝ inches in diameter, and about 42 inches long; the bore in this is $1\frac{3}{16}$ inches, leaving $\frac{23}{32}$ inch cutting surface,

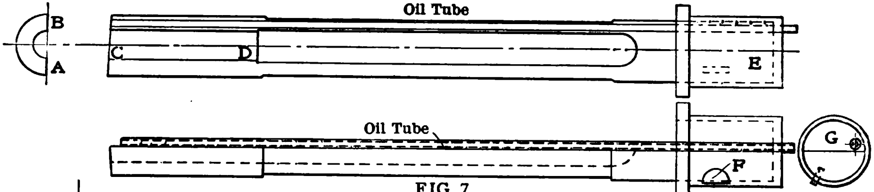


FIG. 7

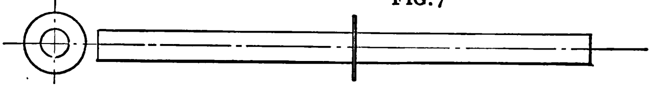


FIG. 8

Special Spindle Drills.

which is shown at *A*. After boring, take the drills apart, put on a milling machine and mill from the end that fits the turret up to the hole bored in the other end (as at *C D*) with a convex cutter about $\frac{1}{16}$ inch larger than the hole, so as to give clearance for the center core. This being done, clear the drill either in the vise or milling machine, letting *A* be the widest point and clearing outside and inside to *B*, the thickness at the latter point being about $\frac{1}{16}$ inch less than at *A*. Also, mill a groove (with a $\frac{3}{8}$-inch convex cutter) the length of the drill and opposite the cutting edge, as at *B*, to receive a brass tube for water or oil supply, this being necessary to keep the cutting edge cool.

Fig. 8 represents the core that is saved after the hole is bored in the spindle. The thin shoulder or collar in the center shows the $2\frac{3}{8}$-inch size, these spindles being bored from both ends. *E*, in Fig. 7, represents a bush that fits the turret; *G* is a piece of machine steel — the same length as the part of the drill turned for the turret — sawed in half, thus making a half circle. This piece is placed on the drill to complete a full circle, and the bush *E* is then driven over both drill and piece *G*. The oil tube is connected to *G*, as shown, the water or oil supply coming from the hole in the turret and leakage therefore being done away with. The end of the drill is ground the same as a gun drill. *F* is a Woodruff key to keep the drill from turning. This drill has been used in large machine shops for the past two months with good results.

Using a $2\frac{5}{8}$-inch drill, cutting at about 23 feet per minute, the feed is about 8 inches per hour on .60 per cent. carbon crucible steel. Taking $1\frac{9}{16}$ inch drill on the same material, cutting 40 feet per minute, the feed is 15 inches per hour. The same drill on machine steel will drill 23 inches per hour. The stock saved on a 24-inch lathe spindle with $2\frac{1}{8}$-inch bore equals 14 pounds of $1\frac{3}{16}$ inch round crucible steel; this can be used for different details on the lathes. Therefore the cost of boring is very low.

DRILLING TOOL STEEL

Many a machinist has spoiled his chances of a soft berth in the Hereafter by a superfluous use of profanity — to say nothing of all the cooling liquids, such as turpentine, soap water, etc., known to him — while trying to drill a piece of hard tool steel by using a very slow speed. He will have the power slowed down still further, but, alas! with no better results than keeping the emery wheel hot grinding the drill. Now, my dear brothers, the point in drilling hard steel is — the point of your drill. It has to cut before the lip, so speed up your drill until the point cuts instead of flattening and you will have much less trouble. We prefer drilling tool steel dry, cooling the drill in a can of water before hot enough to draw the temper. This, of course, does not apply to drills made of high-speed steel.

A FACING CUTTER

Here is a sketch, Fig. 9, of a tool used in some English shops for facing up working surfaces for

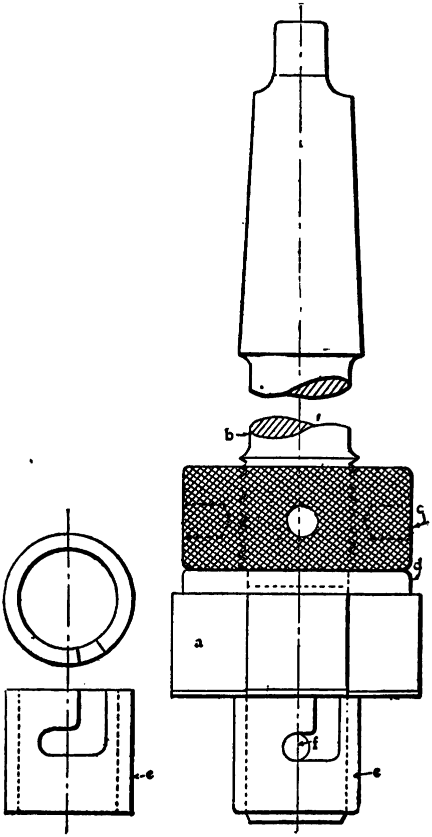


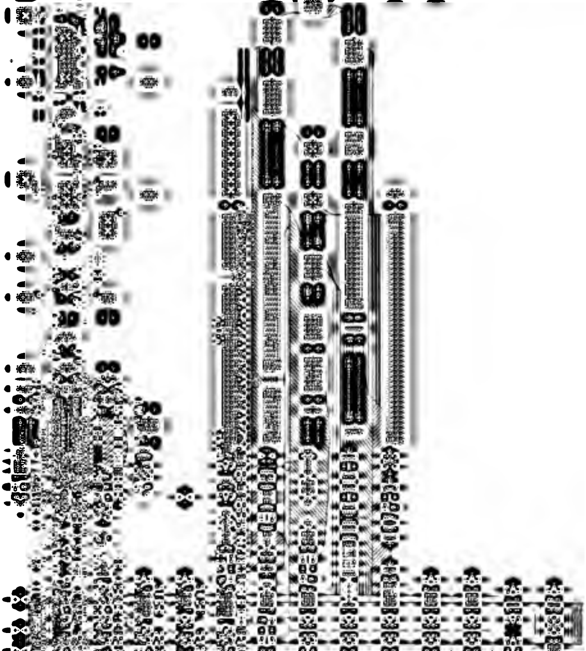
FIG. 9. — A Facing Cutter.

nuts, bolt heads, etc., on work that has not to be machined all over. The cutter *a* is held fast in the bar *b* by the nurled nut *c*, with a steel washer *d* between, as shown. The bush *e* is of hardened steel, with a slot in it that fits over the pin *f* which keeps it in place on the bar. One bar will cover a good range of work, with a number of different sizes of bushes, and the latter are easily changed to suit different holes.

CUTTING OIL GROOVES WITH A DRILL PRESS

THIS sketch shows a tool that was designed for cutting oil grooves, and used in an old drill press. By means of the long feed lever the grooves are cut with one downward stroke 1/16 of an inch deep. This depth can be increased by adjusting the rib upon which the tool cutter slides. The tool shown in Fig. 10 is for cutting straight grooves, but it can be changed to cut a spiral groove. This tool has been used on phosphor bronze bearings of diameters from 5/8 to 2¼ inches by ¾ to 7 inches long, with perfect

[illegible]



[illegible]

a spring to keep the cutting tool *D* back against the rib *G*. *E* is a hole for the chips to fall through, and *F* is the base clamped to the drill-press table with the vertical stud *H*, which carries the rib *G*.

COMBINATION TOOL FOR THE DRILL-PRESS

The sketch Fig. 11 shows a piece to be machined, a fixture for holding the piece, and a combination tool for doing the work. As the lathes were overworked it was decided to make these tools for the drill press. The results were so satisfactory that all work of this kind is now done in the drill press.

In the sketch, *A* is a mill with a shank to fit drill-press spindle, and *B* a shell mill made to fit on *A*. The tool *C*, which turns off the outside of the work, rests on a key or tool block *D;* thus the tool has a very fine adjustment. *E* is a cast-iron collar grooved to receive tool *C*. The mill *B* is split part way down, and is clamped to *A* by set-screws *F* which also hold tool *C* in place. The holder *G* — which is secured to drill-press table — is a forging with two hubs, *H* and *I*. Hub *I*, which is turned to fit hole in work *J*, we will call a chuck. It is bored out taper to receive plug *K*, and is split so it will expand when *K* is drawn down by key *L*. A steady-pin *M* enters the hole in mill *A*, when it is brought

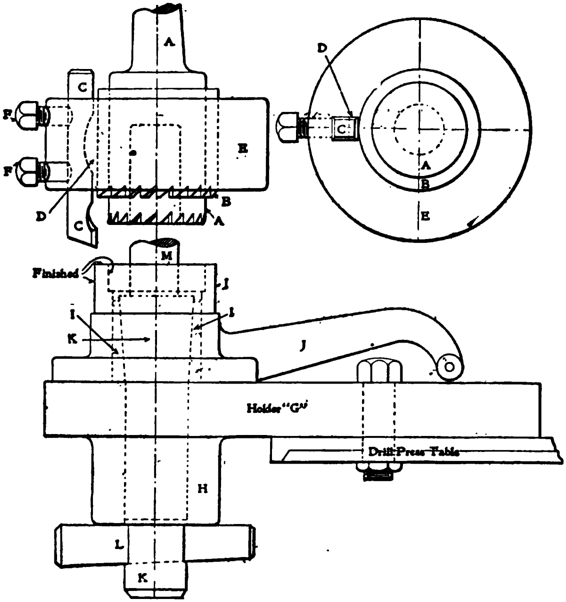


FIG. 11. — Combination Tool for Drill Press.

down to the work, and a step on the drill-press spindle gives the proper depth of cut.

TURNING BOSSES IN THE UPRIGHT DRILL

Shops frequently have plenty of work for their lathes and not quite enough to keep the drill-press hands busy. The sketch shows how the work of turning bosses can be done on the drill press quicker than in the lathe. Large castings that will not swing in the lathe can be set under the drill, and when the hole, as *N*, is drilled, and without removing or resetting the work, the cat-head *C* can replace the drill socket and boss *B* may be turned to the proper diameter.

In Fig. 12 the body *C* of the tool may be made from either a forging or a casting. Two self-hardening steel-cutting tools *D* are used and can be easily set by means of the set-screws *E*. Where the bosses to be turned have been bored, the extension arbor *F* may be used also as a guide with a guide bushing *G*, made to fit the hole. Should the bosses be long and not to be bored, then the arbor may be cut off at *H*, the end of the taper fit.

The arbor is fastened to the body *C* by the taper pin *K*. The key *M*, which locks the drill spindle *P* to the shank of arbor *F*, also extends at each end through the body at *N*, thus removing the torsional stress from the shank.

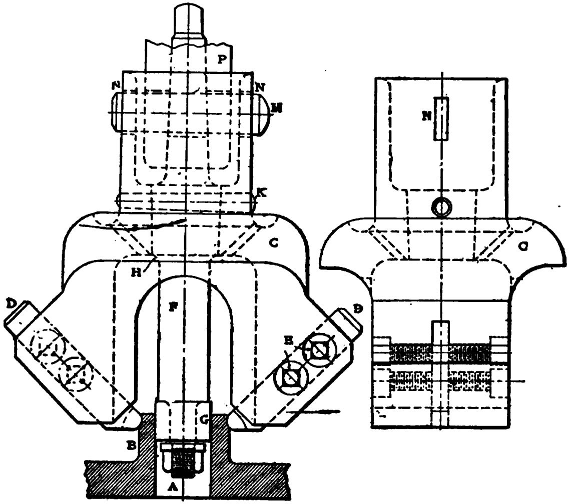


Fig. 12. — For Turning Bosses on the Upright Drill.

A large number of these tools are in use by a locomotive works, and are giving the very best results.

TAPPING LARGE WORK IN A DRILL PRESS WITHOUT A TAP

In a small machine shop whose business it is to repair anything, from a pocket-knife to a locomotive, the ingenuity of the machinist in charge is more often put to the test of devising new ways of doing a job than anywhere else.

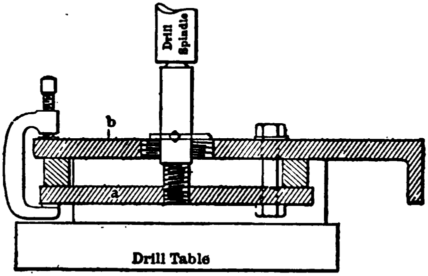


Fig. 13. — A Vertical Lead Screw.

A few days ago, a broken apron belonging to a large lathe was brought in for repairs, to be returned in three days' time. The stripping of the parts, molding, and casting the new apron left but one day to machine it. Two of the large gear studs to be refitted were threaded ten to the inch, but there being no lathe large enough to swing the apron, chasing a thread in this manner was out of the question. Accordingly, the tip of the boring bar used for making the holes was turned down to $\frac{3}{4}$ inch and threaded ten threads per inch. An ordinary iron strap *a* was tapped to match and clamped just below the apron *b*, to be threaded as shown in the accompanying sketch, the strap acting as a leader for a thread-cutting tool which was inserted in the boring bar. Fig. 13 shows how this was done.

A SENSITIVE DRILL ATTACHMENT

WE lately had some thirty thousand $\frac{3}{32}$-inch holes to drill in a number of steel plates, No. 12 gage. We found soon after we started that we had tackled a pretty big job, as we had but one sensitive drill, and that would only drill near the edges of the plates. As other means for drilling had to be provided, the large drilling machines were rigged up with a high-speed sensitive attachment, as shown in the sketch, Fig. 14. The rack was removed from the sleeve which was clamped in. the machine, and the arm *A* was loosely fitted to the sleeve and held up to the frame by a collar *B*, permitting the arm to swing freely; the pulley *C* was made of a piece of plank and driven tight on the lower end of the spindle.

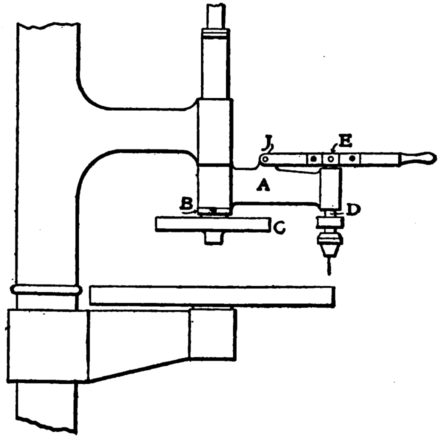


FIG. 14. — High-speed Drilling Attachment.

The spindle *D* was a nice fit in the outer end of the arm; the small pulley was driven on, and the lower end of the spindle fitted to an Almond chuck. The top of the spindle was turned down for the thrust collar *E*, which was held in place by a washer fastened on the end of the spindle by a cap-screw. The lever was slotted at *J*, and two short pins were driven in to enter suitable holes in collar *E*. An ordinary leather belt was used for driving; the small pulley being 1½ inches and the large pulley *C* about 11 inches in diameter, the centers of the spindles being less than 16 inches. The lever was used for swinging the arm and for drilling, the arm swinging through nearly an entire circle. The radial feature was of great advantage as the sheets were so heavy that we found it necessary to use rollers to facilitate rapid and accurate handling.

AUTOMATIC WATER VALVE FOR MULTIPLE-SPINDLE DRILLS

In multiple-spindle drilling, where the use of soda water or other lubricant is required for the cutting tools, it is customary to convey the lubricant from a central source of supply, distributing to the several spindles by means of suitable piping. The flow at the spindle in use is regulated by means of a stop-cock or valve, which must be opened by the operator at the beginning of the cut, and closed again at the finish. This requires an appreciable amount of time, and when multiplied by the use of several spindles often amounts to quite a percentage of the time required for performing the entire operation.

Fig. 15 shows the method adopted by the writer some years since for avoiding this loss by causing the regulating valve to open or close automatically with the upward or downward movement of the drill spindle, entirely independent of the operator.

In the sketch, *a* is an arm, one end of which is pivoted to the drill-press column, the other end carrying an eye with a hole sufficiently larger than the drill spindle to allow the arm free play up and down after the spindle is passed through the eye. In this instance the eye was made of sheet steel, and riveted to the end of the arm, the hole being made about ⅛ inch larger than the drill spindle.

This lever was connected to the handle of the valve by the link *b*, causing the valve to open and close with the upward and downward movement of the lever *a;* which was held at its lowest position against the stop-screw *d,* by means of the coil spring *c,* in which position the valve is open.

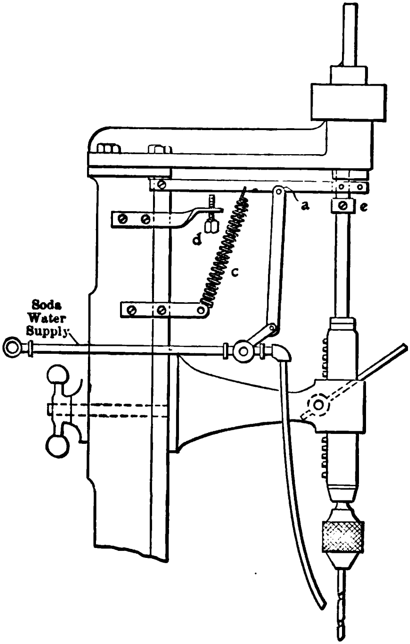


Fig. 15. — Automatic Water Valve for Multiple-spindle Drills.

Upon the drill spindle is placed the collar *e*, held in position by a set-screw.

In operation, the valve is fitted to move freely, a slight leakage being of no consequence, the collar *e* being adjusted to hold the end of the arm *a* up against the upper bearing of the drill spindle when the spindle is in its highest position, when the valve is closed. The spring *c* is adjusted with sufficient tension to freely work the valve when the end of the arm *a* is released by the downward movement of the drill spindle and collar *e*. The tension of the counterbalance spring of the drill spindle should be sufficient to return the spindle to its highest position when the feed lever is released, thus holding the valve closed while the spindle is running idle.

This sketch is drawn from memory after an elapse of ten years or more, and the original rig was made under conditions which made it necessary to not only draw the materials from the scrap heap, but also to keep its construction more or less of a secret.

It is possible, however, that it might have been better designed had it passed through the hands of an expert and the work done under different conditions. Although its construction was somewhat crude, it proved itself a great success, and was continued in use on bicycle work for several seasons with excellent satisfaction.

In this instance the lubricant used was soda water fed by gravity from an overhead tank, and distributed by means of a main and suitable branch piping to the several drill spindles, the drainage being collected and returned again to the overhead tank by a suitable pump.

TWO DRILL-PRESS KINKS

Most machinists who have taken charge of plants for productive purposes have found themselves up against a proposition like this: "Yes, we could do that job on this machine only for such a contrivance," or the tools for that job were made for such and such a machine which is now, and is likely to be, full up of work. Things of this kind sometimes make a man worry.

We had a job to do which was originally done on a certain machine which was now overcrowded with work. Some other way had to be found, as hand work could not be thought of.

The sketches herewith show the way which was tried, and which was in every way a success. Only that part of the job is shown which is likely to prove of general interest. The job in question could be done on the sensitive drill if we could devise some way to bring down the tool to the work, and so leave the operator the full use of both hands to manipulate the work.

This meant some sort of pedal arrangement. Fig. 16 shows the general arrangement which was got out and is shown in position.

A gray-iron disk was taken and bored out to fit on the handle part of the machine. It was fixed by two screws as shown, had a groove in its periphery and four slots were made to miss the lever.

A gray-iron bracket *B* was fixed to the machine by two cap screws as shown. This was furnished with a pin *C*, on which to fix the spring *D*. At its lower extremity it was fitted with a grooved pulley *E*. An old piece of cycle chain *F* was

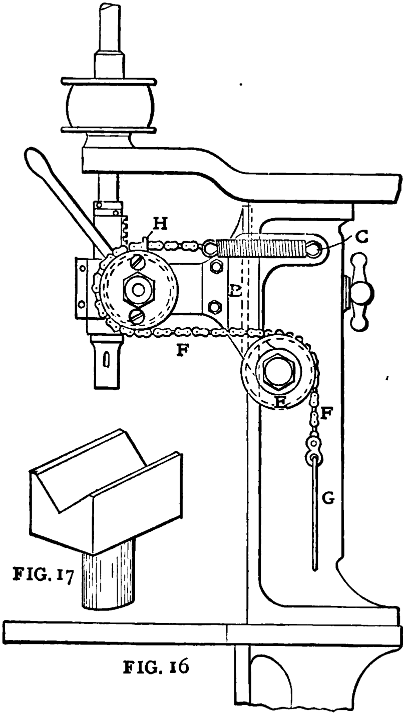


FIG. 17

FIG. 16

Foot Feed for Drill.
Press and V Center Block.

fitted as shown. A wire rod *G* was attached to the chain and taken down to a pedal on the floor; this, however, is not shown, but consisted of a piece of wood with a hook in its center, and hinged to the floor at its back end. A peg *H* was driven in disk *A* to make a positive drive. When not in use the chain was simply taken off the disk, leaving the machine free for its ordinary work. This could be moved up and down the drill column with the head and used at any point by varying the length of rod *G*.

Fig 17 shows a sketch of a block with a stem. Most makers of sensitive drills fit them with a cup with a stem to fit in a table bracket for drilling the center holes for lathe purposes. The stem of the V-block shown fits in the same place and has proved very useful.

If the manufacturers of drills were to fit them with this device it would be appreciated by most machinists, as it would be a welcome addition to the outfit of any tool shop.

TAPPING NUTS RAPIDLY ON THE DRILL PRESS

Having a great many nuts to make of varying sizes, from 1/4 to 3/4 inch, mostly of a special thread, the drill press was used advantageously with the fixture shown. The body *A*, Fig. 18, of the fixture is of cast iron 3 x 2½ x 6 inches, with a

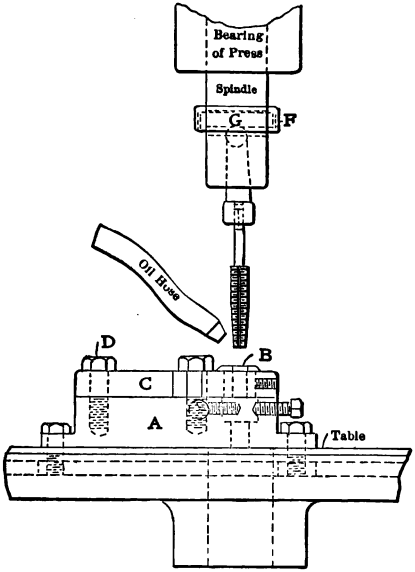


FIG. 18. — Nut Tapper for Drill Press.

1$\frac{3}{16}$-inch hole drilled all the way through and counterbored 1½ inches diameter and 1 inch deep. Two ½-inch set-screws of ample length for all adjustments were put in 120 degrees apart and at the center of the depth of the counterbore.

These screws clamp the blank nut and bring it central under the bushing *B*. It is only necessary to use one screw after the first nut has been set. The bushing *B* is carried by the piece *C*, which pivots on the bolt *D*, allowing the removal or insertion of the work. *C* is cut out on one side for bolt *E*, which clamps it when in working position. It also acts as a stop. *B* is held in place by a set-screw so as to allow for changing to any desired size. *A* was clamped over the hole in the press table and brought central with the spindle.

A Novel Collet Ejector

The press was arranged so it would be unnecessary to stop to change from drill to tap, or the reverse, by means of the collar *E*, which was a loose sliding fit to the press spindle and milled for a tool-steel piece *G*, shown dotted, which was a loose fit in the slot of the spindle. This slot was elongated to allow for *B*, being heavy enough not to bend and so *G* would not interfere with the tang of the collets.

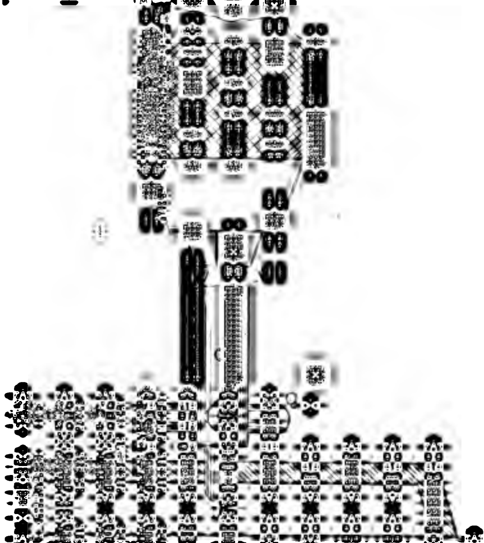
With this arrangement it was only necessary to let the collar *F* strike the bearings of the press to eject the collets. In fact, sufficient weight was added to the counterbalance of the press to make this operation automatic, by setting the trip of the feed. The collet was made a loose fit for the shank of the tap so the tap would drop out when it was through the nut.

The taps were made longer than the ordinary tap, and were run through at the same speed as the drill. A pump was borrowed from an old Brown & Sharpe miller and driven from the feed cone of the press, giving a fine cooling stream of cutting mixture. With this arrangement an apprentice drilled and tapped thousands of nuts rapidly and accurately.

BORING LARGE HOLES ON A SMALL PRESS

THE sketch, Fig. 19, shows how an unusual job was accomplished in a simple manner with the best means available, which were, to say the

[illegible]



[illegible]

cutting tool shown we did the job on the small drill.

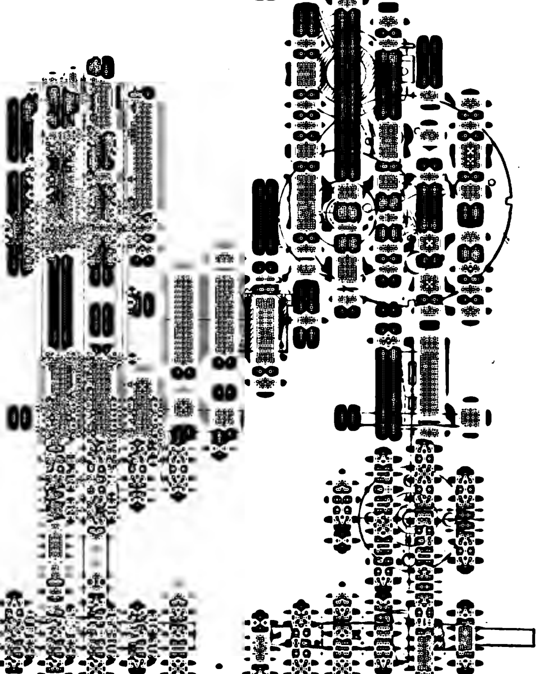
First we drilled and reamed two small holes the required distance apart for the centers, as shown at *K*, as locating and truing points of the tit *M* of the tool *R*, as shown. The tool was fastened in the chuck and the work located and clamped to the table, and the holes finished as shown in the sketch. The tool used for this job can be used for a variety of others as well.

THE DRILL PRESS CONVERTED INTO A CHUCKING MACHINE

THE enclosed sketches, Fig. 20, show a way of arranging a drill press for doing such simple operations as drilling, boring, tapping and facing on small pipe fittings, flanges, collars, etc., these operations, when performed in the ordinary way, requiring a lot of time for changing the different tools on the spindle of the machine. *A* is a small but powerful universal chuck fitted on the end of the spindle. *B* is the circular table bored, as shown, to receive four tool-hold-

[illegible]

[illegible] in [illegible] the



[illegible]

[illegible] the [illegible] be

readily understood that after pulling the latch the plate can be turned, and any of the four tool-holders brought perfectly central with the chuck *A* and the spindle of the machine, the latch holding the table in the four different positions. Whenever boring and facing operations are to be performed, a bar like that shown at *E* can be used, its end fitting bushing *F*, which acts as a guide. In this way boring and facing can be done with uniformity and precision. If the chuck is too heavy, it can be balanced.

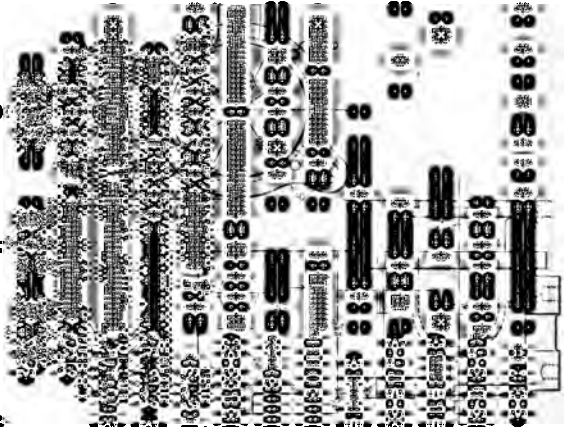
A LATHE JOB ON THE UPRIGHT DRILL

Fig. 21 shows the details of a gasoline engine carburetor made of bronze, and the other sketches show the drill-press tools and jigs that enabled this part to be machined on a drill press instead of an engine lathe. A first-class machinist was required to machine the casting on a lathe, but a cheaper man with the aid of these tools did the work on a drill press in about one third the time.

Fig. 22 shows the fixture for holding the bronze casting for the first operation. The parts ma-

[illegible]

[illegible] the [illegible] which [illegible] red [illegible] for [illegible] on



[illegible] Machined

[illegible] posts [illegible] and, [illegible] ing [illegible] socket.

[illegible] tool

used for the first operation is shown in Fig. 23. It has a cast-iron body and four inserted steel blades. It will be noticed that the cutting edges are radial (which is contrary to general practice for brass), the blades are ground to an angle of 10 degrees for clearance. Two set-screws for each blade hold them in the body. This tool works very satisfactorily.

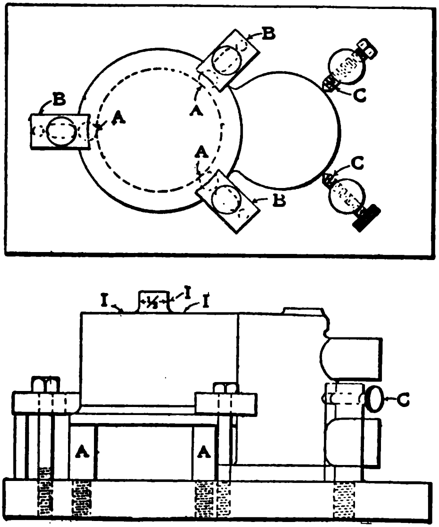


FIG. 22. — Jig for First Operation.

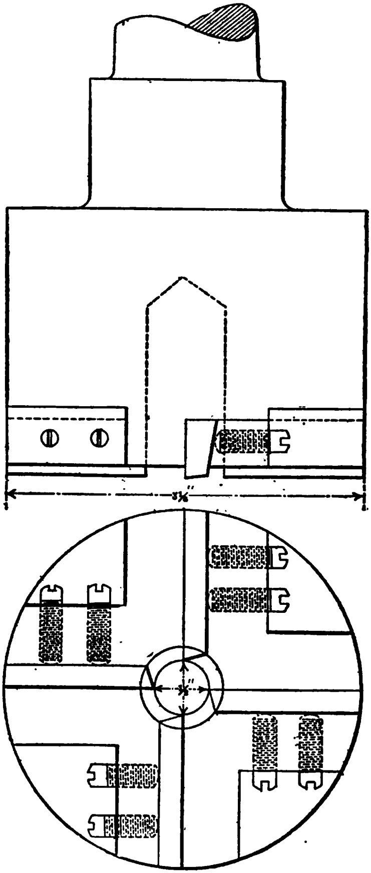


Fig. 23. — Hollow Mill and Facing Tool.

Fig. 24 is a box jig for drilling all the holes except the eight $\frac{3}{16}$-inch tap holes on the top.

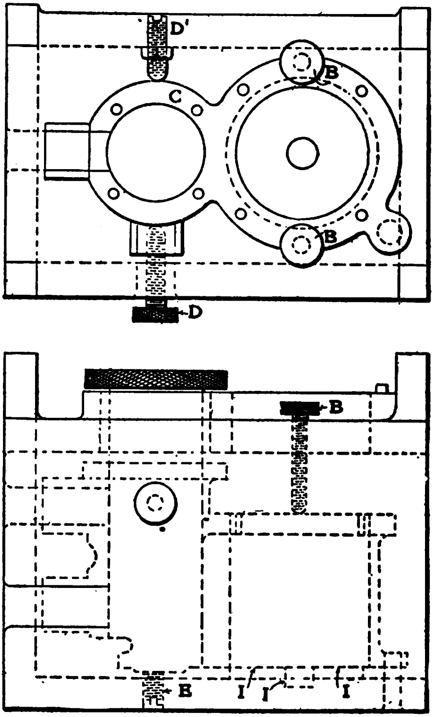


FIG. 24. — Box Jig for Drilling.

The casting is located by the previously finished surface *I*, and is held down by the two set-screws *B B*. The part of the casting marked *C* is located by two set-screws *D D′*. *D′* is stationary when once adjusted, being held by a lock nut.

The boring tools used for boring the $2\frac{5}{8}$-inch and $1\frac{9}{16}$-inch holes are shown in Figs. 25 and 26. Fig. 25 is a four-lip reamer with a short drill at the end to spot the work for the next operation. An adjustable stop is provided at *C* to regulate the depth of the bore. The boring tool for the $2\frac{5}{8}$-inch hole, shown in Fig. 26, is made of machinery steel in the body. The cutter *A* is held by a taper cross-pin driven through the side. The cutting edges of this blade are radial, the same as in the tool shown in Fig. 23, and are ground to an angle of 10 degrees for clearance. A drill is inserted in the end to spot the work for the next operation. The bushing *D* is made of cast iron, and is a neat running fit in the body of the tool.

In cases where a bushing acts as a bearing for a round bar, as in this case, cast iron is to be recommended; these bushings, after being in use for some time, do not show wear. This tool is

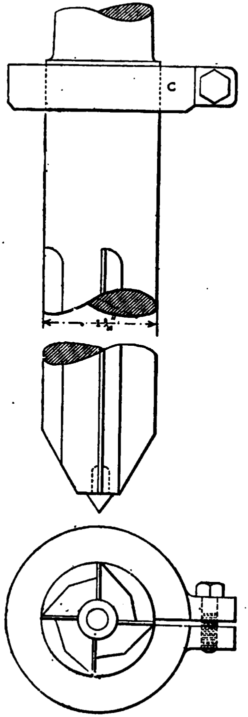


FIG. 25.

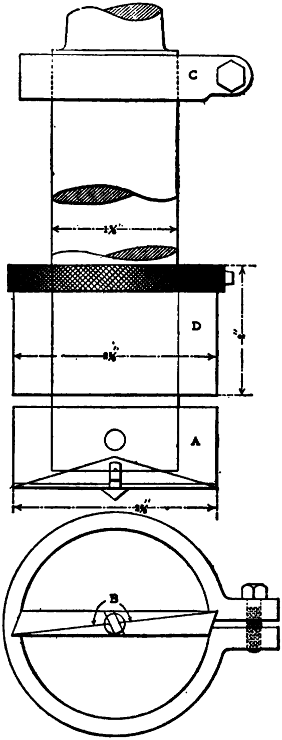
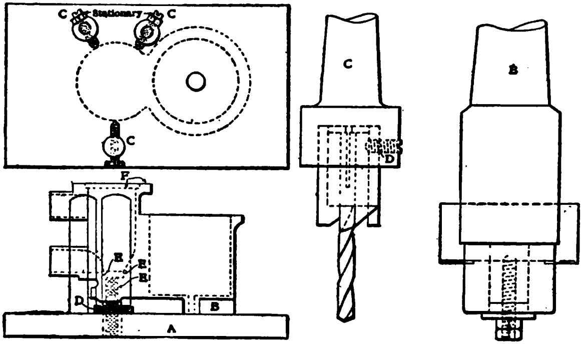


FIG. 26.

Boring and Internal Seating Tool.

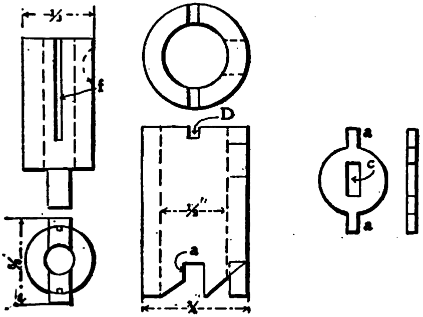
also provided with a stop *C*. It has been found to be a very efficient tool for boring and facing. Two of each of these tools, Figs. 25 and 26, are provided for this job, one for roughing and one for finishing. The allowance for finishing is $\frac{1}{32}$-inch in each case.



Figs. 27, 28.—Fixture for Third Operation and Combination Drills and Counterbores.

Fig. 27 shows the fixture for the third operation. It consists of a cast-iron plate *A* on which is mounted the circular piece *B*, having a hole in the center for the finished projection on the casting. Three set-screws *C C C*, two of which are stationary when set, hold the piece in position sideways, and a small screw *D* acts as a jack to keep the casting from tilting under the pressure of the tools.

The style of tool used for counterboring and facing the parts marked *E* and *F* is shown in Fig. 28. *B* is the tool for counterboring and facing the part marked *F*. It will be noticed



FIGS. 29 to 31. — Details of Fig. 28.

that the outline of the blade is not quite correct. *C* is a combination counterbore and drill. It was sought to design a tool that could be easily taken apart for grinding and that could be readily adjusted where necessary to keep the relative position of the two counterbores. The ⅝-inch counterbore, Fig. 29, fits into the ¾-inch counterbore, Fig. 30; the cutting blades of Fig. 29 fit into the slot *a*, Fig. 30. Fig. 31 is the drill driver enlarged. The lugs *a* fit into the slot *b*, Fig. 29. The end of the drill is filed to fit the slot *c* in the driver. The whole assembly is held together by the set-screw *D*, Fig. 28.

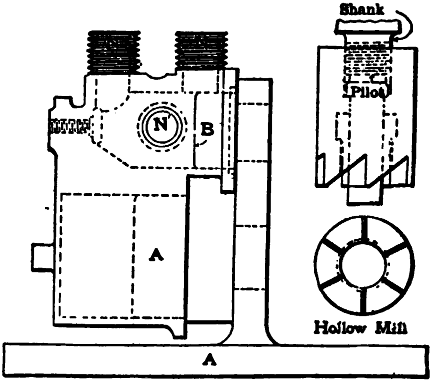


FIG. 32. — Angle Plate for Milling and Threading the Nipples.

Fig. 32 is a cast-iron angle-plate jig for holding the casting during the operation of boring and threading the nipples *N* and *N′*. Two studs, *A* and *B*, on the plate fit into the previously bored holes in the casting, and suitable clamps, not shown, are provided to hold it in position. The nipples are milled off externally by a hollow mill and are threaded by an ordinary round die held in a special holder. Of course, when the nipple *n′* is milled, the fixture is turned down on its side. The hollow mill with its pilot and shank is shown at the side, so that little or no explanation is necessary.

While on the subject of hollow mills we will mention a kink which is not generally followed or known. The common ailment of this class of tools is that they stick on the work after having been used a short time. To overcome this difficulty the full length of the cutting surface is filed with clearance, as indicated in the sketch; in other words, make an external reamer of it. This style of hollow mill never sticks on the work, and the hole need not be made tapering, as is necessary with ordinary hollow mills.

Fig. 33 is a fixture for milling the face marked *V*. This job could not be done on the drill press and had to be taken to the milling machine; the clamps holding the work against the angle-plate are not shown.

Fig. 34 is the jig for drilling the eight $\frac{3}{16}$-inch tap holes for the cover plate. It consists of a casting with bushing inserted for the holes to be drilled, and carries two studs $2\frac{5}{8}$ inches and $1\frac{9}{16}$ inches diameter, which fit into the bored holes and thus locate the jig. The work is held in the fixture shown in Fig. 34 during this operation. With the exception of milling the face, all the machining operations on this piece were done in the drill press. The jigs and tools shown were designed so as to be easily made.

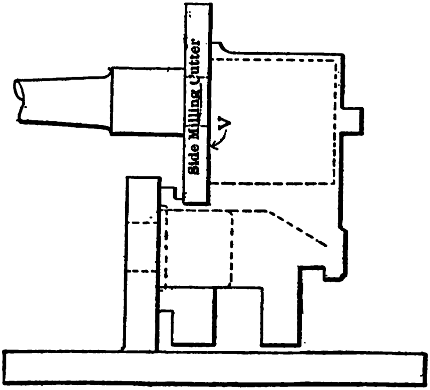


FIG. 33. — Milling Machine Jig for Facing.

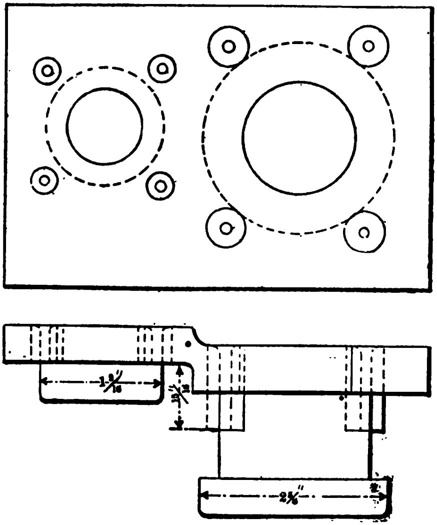


FIG. 34. — Jig for Drilling Small Holes.

AN AMATEUR'S DRILL PRESS

THE sketch, Fig. 35, represents a simple and inexpensive amateur's drill press. *a* is a sewing-machine drive wheel, *b* a hand wheel such as is used on a 3- or 4-inch globe valve, or the driven wheel from a sewing-machine head, *c* a piece of $\frac{3}{8}$-inch brass pipe threaded its entire length, *d* a

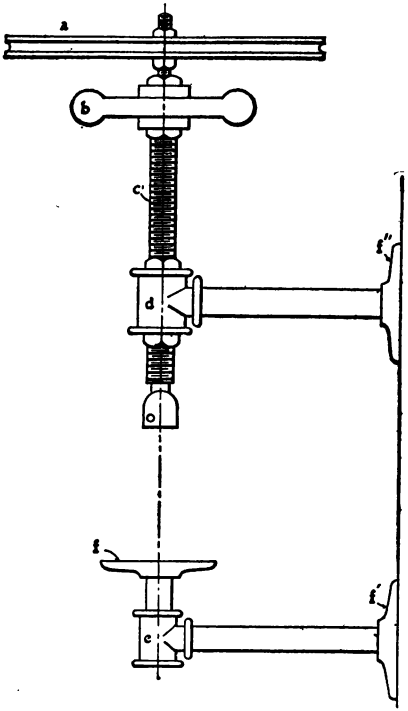


FIG. 35. — An Amateur's Drill Press.

¾-inch T bushed and bottom with ⅜-inch bushings. The hand wheel *b* is fastened to the pipe *C* by pipe lock nuts. The drive wheel *a* is fastened by lock nuts to the steel rod or drill spindle that passes through the brass pipe *c* by lock nuts, the drill chuck being fastened to its lower end; *e* is a ¾-inch T which allows the chips and oil to pass through; *f f′ f″* are pipe floor plates. A long driving belt is used, thus allowing for the vertical movement of the drive wheel as the drill is fed to the work.

A COUPLE OF DRILLING KINKS

When drilling large holes some omit the gaging by first drilling a small hole — say, ⅛ inch — to the depth to which the point of the large drill is to go. This small hole is not liable to run out, and acts as a leader.

When drilling holes for a slot in a shaft or for cutting out plates of irregular form, first drill all the holes through with a smaller drill, as Fig. 36, and when enlarging those holes first take every other hole, which will leave the same amount of stock on both sides of the remaining small holes, and which will allow the crowding together of the holes as in the sketch, without the danger of the drill running into one of the neighboring holes.

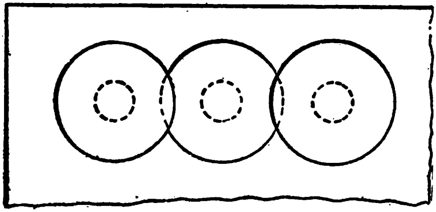


FIG. 36. — A Drilling Kink.

DRILLING AN OBLONG HOLE

WE had a casting in which we wished to make an oblong hole *a*, Fig. 37; there was nothing very accurate about it, as it was simply a clearance hole made oblong to allow a bolt to be moved a little sidewise. We had to jig the casting twice for other holes, so we simply drilled one hole through solid stock (using the first jig) with a

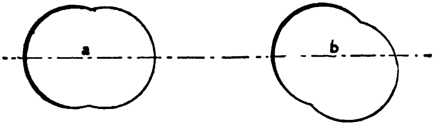


FIG. 37. — Drilling an Oblong Hole.

twist drill. In the second jig we had the bushing so located that the stock was cut away on one side of the first hole to form the oblong hole; we also used a twist drill for the second operation, depending on the bushing to keep the drill from running off too much. This may seem a pretty crude way to get out work, but it proved a rapid method, and was within the *good enough* line. We used this jig with gratifying results for a year or more, when suddenly the holes assumed the shape at *b*. We expected the drill to run off toward the other hole and had made allowance for that, but to have it run off out of line was a puzzler. Our first thought was that the bushing had become worn, but a careful examination failed to reveal any defect there; an examination of the drills, however, revealed the "Jonah."

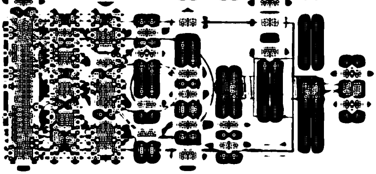
When the jig was first used we had an old-fashioned drill, but later we had used the new style drill, with stock (except a small spiral strip on the cutting edge) milled off for clearance. The drill was consequently not backed up by the bushing in a straight line, but spirally. To our mind this explains the tendency sometimes exhibited by drills to run off at an angle to a blow hole. The cure in our case was an end mill made with considerable bevel and having a body which filled the bushing closely.

We think that for such work an end mill should be used with square, *i.e.*, radial cutting lips. Lips so made do not crowd off, but tend to go straight through and consequently the bushings are worn much less rapidly and the work is better done.

DRILLING AND BROACHING AT ONE OPERATION

We had a lot of small collars to make with a slot or keyway for a driving pin to enter. Formerly the slot was produced by first drilling a hole, then broaching out the remaining stock, and then, as the broaching raised a large burr, it was necessary to ream the hole, making three operations in all. This being too expensive for so simple a job, a jig was made by which the slot in question was finished in one operation, re-

[illegible]



[illegible]

as shown in the section, Fig. 39. The button-shaped head of the drill socket is made to fit the straight part of the hole, the angle of the front and back of the button being the same as that of the sides of the hole.

In operation the socket and drill are fed down the straight part of the guide hole until the pointed part of the socket strikes the angular bottom of the hole, forcing the jig to one side and the drill to cut its way out into the hole of the collar. The dotted lines in the section show the drill and socket in its final position. A common twist drill is used, and as it has to do considerable side cutting, it is backed off accordingly on an emery wheel, and as a small portion only of the drill projects from the holder, short stubs of drills that are of no other use can be used for this purpose. The button-shaped head of the holder, as well as a portion behind it, is hardened. Fig. 40 shows the holder with taper shank and headless set-screws for holding the drill.

STRAPS WITHOUT BLOCKING

THE cuts herewith in Fig. 41 show a device which is of course not at all new but which it is well to call attention to, as a reminder to the older and a suggestion to some of the younger workers. A few straps of different lengths and

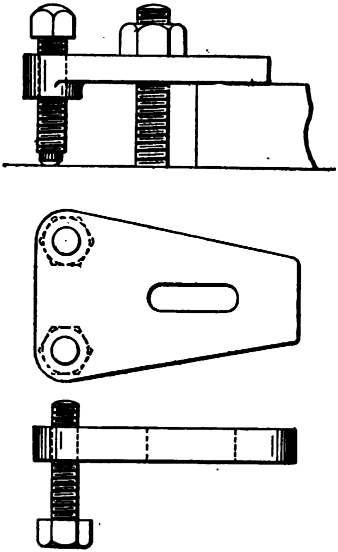


FIG. 41. — Straps without Blocking.

sizes, slotted for the bolt and all tapped alike at the rear end, and then a few screws of different lengths an easy fit in the holes, will be found a great convenience, dispensing with a lot of blocking and securing more satisfactory setting of the strap. The screws may be used with the head either above or below the strap, according to the hight.

CLAMPING WORK FOR DRILLING

FIG. 42 shows a novelty in a clamp-dog. The stock required for the driving-pin, say at *O*, admits of the extending of the bars at each end without increasing the swing of the dog or clamp; so that while the clamping screws in the inner holes make the tool stiffer for round work, putting them in the holes farther apart gives the clamp more range for flat work. Then by means of supplementary feet fitting holes at right angles to the binding or clamping screws, a good drilling stand is formed. By using heavy stock, about $\frac{7}{8}$, and screws and post holes not over $\frac{7}{16}$ inch, the sixteen holes, as shown, can be made without weakening the bars. This stand is very convenient for holding punch shanks, etc., while drilling.

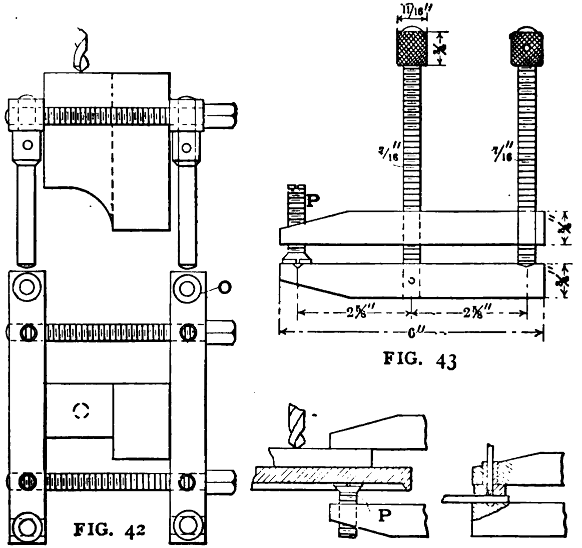


FIG. 42

FIG. 43

FIG. 44

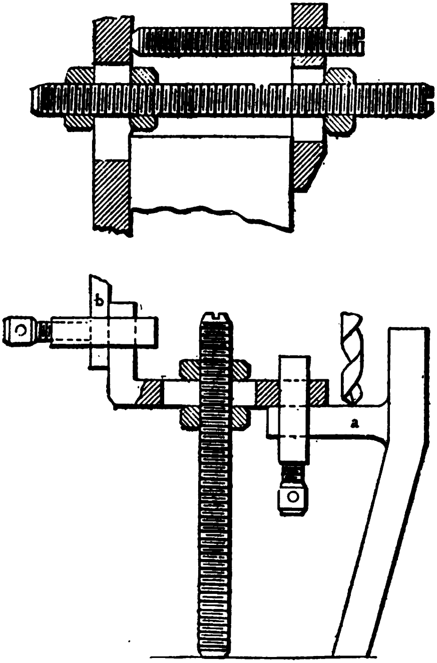
FIG. 45

Clamps for Holding Work.

Figs. 43, 44, and 45 show, to our mind, the best all-round clamp to be had of its style. The screws on opposite sides of the clamps are a barbarism. Make the clamp bars of $\frac{3}{4}$-inch, or better, $\frac{7}{8}$- or 1-inch machinery steel, case-hardened after finishing. Make the distance from the central screw to the screw *P* and the rear screw equal; and get the holes for the screws in the center of the bars. Made in this way the lower arm can be swung round to furnish a flat base, if needed, as shown in Fig. 45. In this view a drill bushing and a locating point are shown as used for setting and clamping work to be drilled to a center punch mark. In Fig. 44 one advantage of the screw *P* is shown, where work is clamped to a small drill-press table having at its under side a ledge that would interfere with the ordinary clamp, unless a block were used below the platen.

In Fig. 46 is shown a stud with three nuts used in connection with a strap and jack-screw for holding work on the lathe face-plate or drill-press table. In Fig. 47 the stud with two nuts is used as a rest for an odd-shaped piece while drilling. The right-angle clamping piece is used in connection with a Besly clamp at *a* in a horizontal position, and at *b* in a vertical one.

Fig. 48 shows the method of holding a piece of work with two clamps in opposite positions, for drilling purposes.



Figs. 46 and 47. — Holding Work in the Lathe and Drill Press.

Fig. 49 is a clamp in a class by itself, for supporting jig work, etc., while being drilled. The

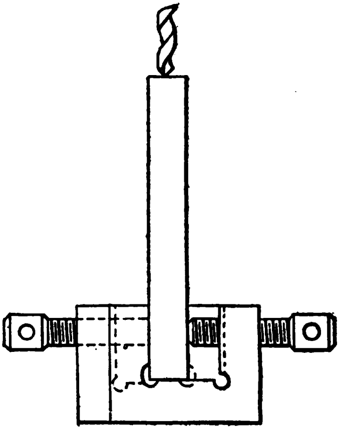


FIG. 48. — Use of a Clamp.

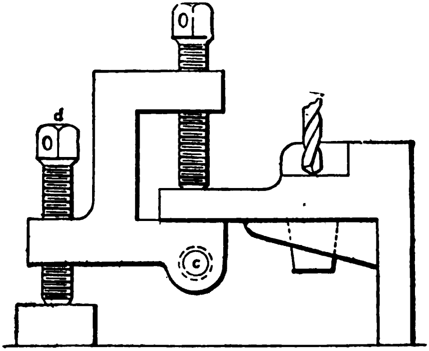


FIG. 49. — Clamp as an Outboard Support.

extra hole at *c* is for a different position for screw *d*.

Fig. 50 explains a very good clamp borrowed by all hands where it is owned. The adjustment of *e* covers one of the steps *f*; the piece *g* is tipped up as it is moved from step to step.

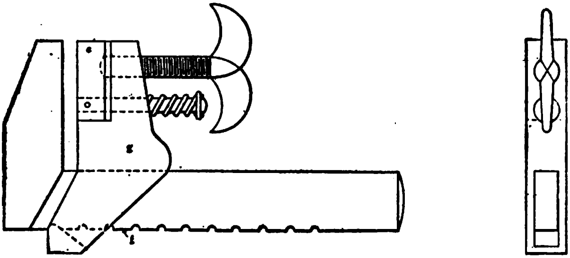
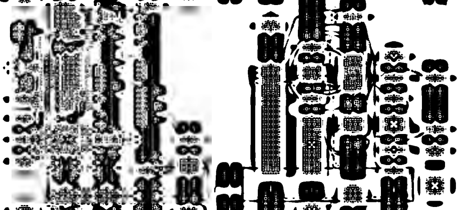


Fig. 50. — Clamp with Adjustable Jaw.

JIG FOR DRILLING COLLARS

The illustration, Fig. 51, shows a simple drill jig adapted for conveniently drilling collars or any work of a similar character. The collar *A* is held in position on plug *B* and clamped by the swinging clamp *C* against the three hardened pins *E*. The motion of the swinging clamp is



drill-press table and the collar is slipped loosely on the overhanging end and against the edge of the table. The table is then swung around until the collar is in the right position under the drill and clamped there, and any number of collars may be drilled correctly. They will not roll and will not slide.

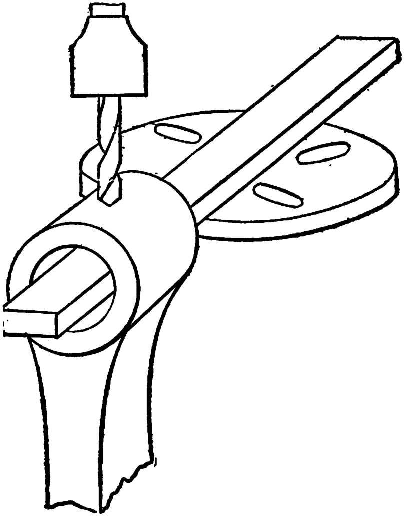


FIG. 52. — Drilling Collars.

In Fig. 53 are indicated the successive operations in drilling, as at *E*, a lot of steel strips. These came to be drilled in lots of 25 to 50, and the holes were required to be in line and equidistant from the center hole within .01 inch. It would not have paid to make a jig because the distances varied in the different lots. We first laid out and drilled holes 1, 2, 3, and 4 in one plate, as at *A*, and then drilled hole 1 in all of them. Plate *A* was then laid on one of the others with a pin in the center hole of both, and hole 4 was then drilled and a pin put in that, when holes 2 and 3 were drilled. All the strips were then put through this operation, and then they were

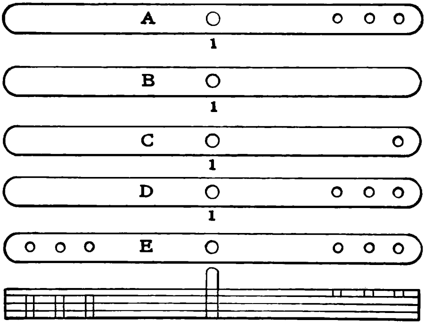


FIG. 53. — Drilling Duplicate Strips.

taken three or four together and drilled on the other end, a pin being first placed in the center hole and another in the end hole as soon as it was drilled, the operation being the same as for the first end.

JIG FOR DRILLING BALL HANDLES

WE required a jig for drilling ball handles. The jigs generally used seemed to be too expensive, so the one shown in the accompanying sketch, Fig. 54, was designed. As will be seen, the screwed bush acts as a drill guide, and at the same time as a means of holding the work in

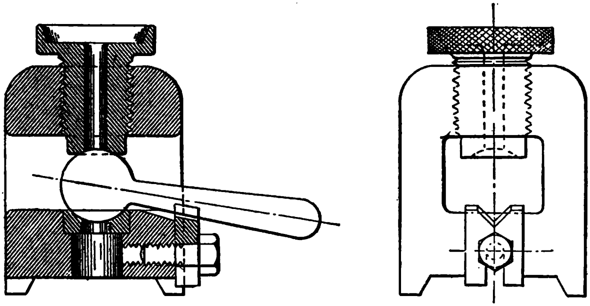


FIG. 54. — Jig for Drilling Ball Handles.

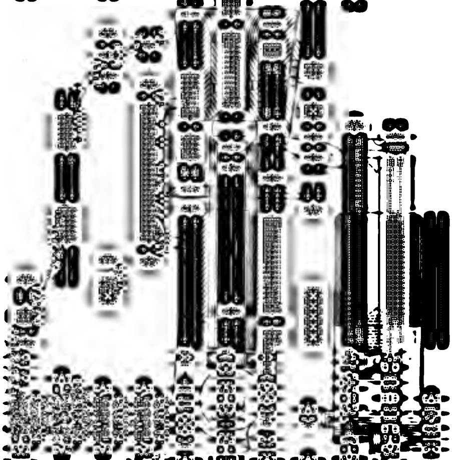
position. The top is hollowed out for conveying soap-suds to the drill. The top of the pad upon which the work rests has the same radius as the work, which prevents marking or marring the surface. We drill four different sizes of handles on this jig, and for each size we have a separate drill guide and pad. The small notched plate at the side gives the required angles.

JIG FOR DRILLING BALL HANDLES

The sketch, Fig. 55, shows another jig for the same kind of work. This jig was first used for drilling $1\frac{3}{16}$-inch holes in drop forgings $2\frac{1}{2}$ inches long; after the forging job was completed the jig was made over to drill handles as in sketch.

A B C is a cast-iron frame; the size and strength of frame is made to suit requirements. *D* is a steel bushing for the drill, and *E* is a piece of cold rolled shaft made a sliding fit in *B*. The steel screw *F*, with holes drilled in head to receive pin wrench, is made a snug fit, or can be made with lock nut to make more positive. *G* is a cam lever for lifting shaft *E*, and *K* is a gage

[illegible]



[illegible]

[illegible]

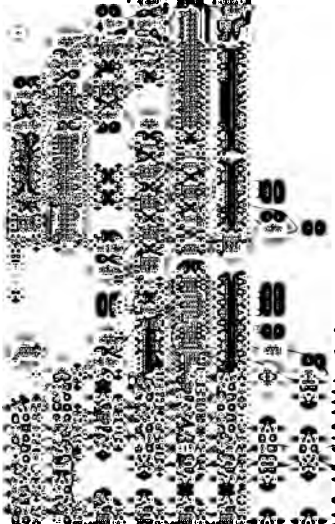
from lubricant as much as possible. We remember an incident where a jig of this kind was used for drilling $1\frac{5}{16}$-inch holes. The operator, a young man, like the majority of men of this class, would work the jig, even if obliged to use a sledge. Well, one day post *E* stuck fast, and it was found necessary to take the jig to a vise and remove the post with a heavy hammer. The trouble was caused by fine particles of drill cuttings (so fine they could not be seen with the naked eye) which had washed down with the soap water and worked between *E* and *B*. To prevent this use a shield made of cast iron and fastened to post *E* as shown in the sketch.

This design of jig has been used for a variety of work by removing bush *D* and shaft *E*.

JIG FOR DRILLING AND TAPPING A BALL

A VERY handy jig is shown in Fig. 56 from the tool room of that progressive Scotch firm of machine toolmakers, John Lang & Sons, Johnstone, near Glasgow. On their machines they use the formed handle as much as possible, and

[illegible]



[illegible]

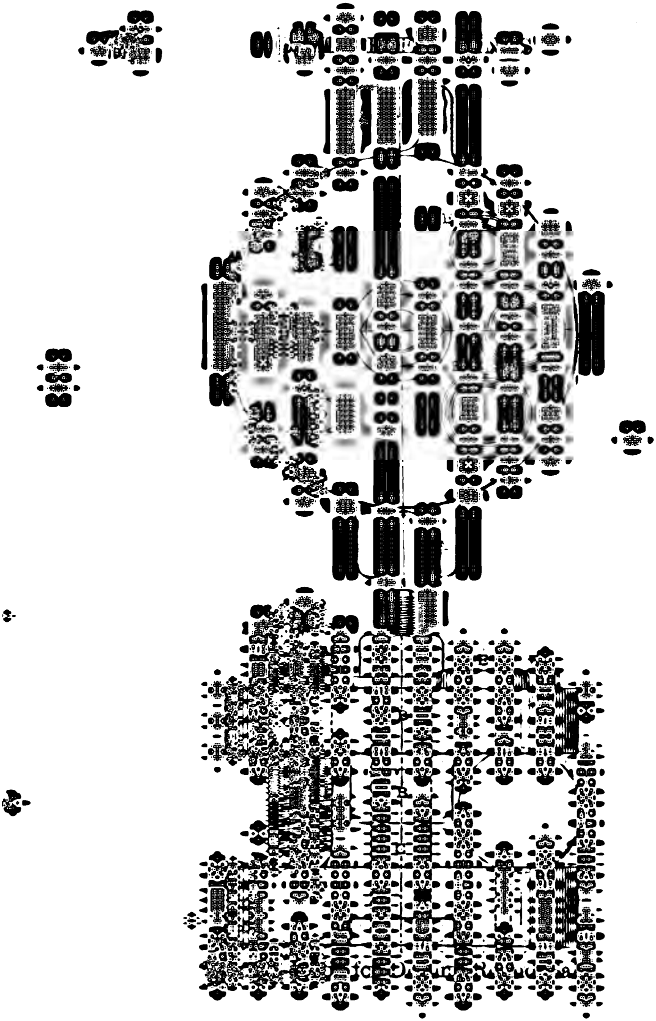
[illegible]

angle as shown in the sketch. *A*, the guide for the drill, is taken out when tapping. *B* and *C* are grips, with their holes beveled so as to bring the ball central for drilling. *D* is the screw, with three handles, by means of which the handle to be drilled is gripped or released. *E* is a plate which is slotted to be raised or lowered to bring the handle to whatever angle is required up to 20 degrees, a line being made on the plate and the degrees marked on the jig.

As will be noticed, at one setting of the plate all handles would be drilled at the same angle without any marking out. The upper set-screw is to keep the grip *B* in position. The lower set-screw has a tit at its end, and the grip *C* has a groove which prevents the grip from turning with the screw *D*. For different sized balls on the formed handles different grips have to be used, also for different diameters of holes guide *A* has to be made to suit. In making different grips care has to be taken that when the center line of the handle to be drilled is horizontal, the line on plate *E* is at the zero mark, or else the angles will not read correctly for all sizes. This jig takes from a ⅜-inch tapping hole, which has an inch ball, up to 1-inch tapping hole, with ball diameter 2¼ inches. The handle to be drilled is shown only in the sectional view.

JIG FOR DRILLING ROUND BALLS

THE accompanying sketches, Fig. 57, show a simple jig or fixture for drilling holes straight through the centers of round balls, such as governor balls for steam engines, round knobs on the ends of locomotive pillars for hand rails, etc. To do this work without some special fixture is rather difficult. The base plate *A* is a round casting with two ears cast on for bolting down. The top plate *B* is a familiar casting with a hub. This is bored to fit the turned stud *C* which is screwed fast into the base plate. The upper end of the stud is reduced in diameter, as shown, to allow a smaller clamping nut to be used, and also to allow more room on the top plate. *E E* are the hardened bushings to steady the drills and *D D D* are the adjusting screws for setting the top plate level for different sizes of balls.

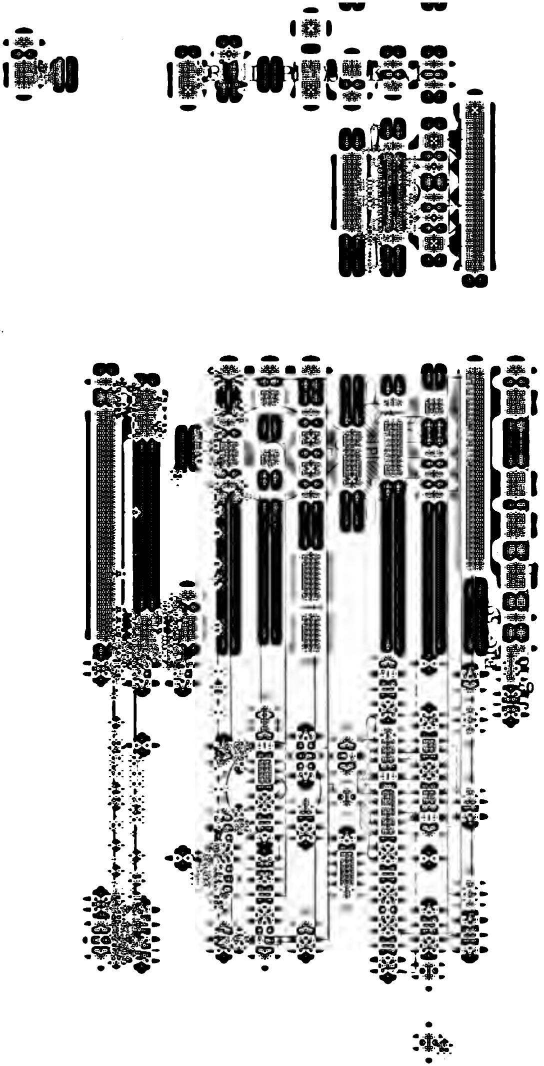


When a round ball or knob is put into the jig and the top plate is clamped down as shown, it is impossible for the drill to run out of the center, as the ball locates itself central with the hole in the bushes. The jig illustrated is intended for drilling three sizes of holes, each bushing being a different size.

JIG FOR DRILLING HAND-RAIL PILLARS

HERE is a sketch of a jig for drilling hand-railing pillars and other work with spherical ends, which may be of interest. It was made for drilling pillars as in Fig. 58, both holes being run through at once, under a multiple-spindle drill, the distance between centers *a* varying from 12 to 18 inches. It can also be used for drilling pillars and rods with just the one hole through, the other end of the rod resting on the V-rest *b*, as shown at the end of the jig, which rest is adjustable for hight to suit different diameters of rods.

The base of the jig is of gray iron, and so are the two heads *c* which slide on it to suit different



[illegible]

[illegible]

[illegible]

the movable jaw *C*, which carries a pin running through *A*, is forced back by a compression spring when released by the eccentric clamp *E*. The flat plates *F*, on which the work rests, are screwed to the bottom of the jaw *C*. Two lugs *G* for the drill bushings (not shown in plan) are cast on jaw *A*. When in use, the jig is bolted to a bracket carried on the drill-press column; the pieces to be drilled are placed on the plates *F*, and clamped fast by means of the eccentric *E*. After drilling, the jaw *C* is released and the work drops through a hole in the plate *B*.

A JIG AND A CHUCK FOR THE DRILL SPINDLE

HERE is a sketch of a jig for a comparatively simple job. The casting, Fig. 61, is to be sized in the holes and tapped to pipe sizes as follows: *A*, 1¼ inches; *B*, 1½ inches; *C*, 1¼ inches; *D*, 1½ inches; *E*, 2½ inches. The edge at *E* is also faced. The work is all done at one fastening of the piece in the jig, Figs. 2 and 3.

Fig. 62 is the body or standard of the jig. The bottom *A* is planed and is permanently bolted to the face-plate of a turret lathe. The two grooves *F* are planed as shown.

Fig. 63 is a slide fitting *F* on Fig. 62. In this slide the piece to be machined is held. The end *G* is forced tight against the bevels *D* by the two pointed set-screws at the opposite end. The

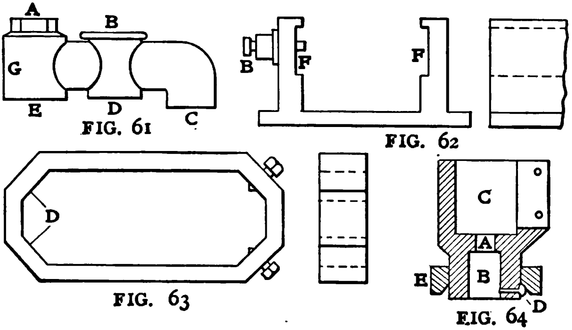


FIG. 61 FIG. 62 FIG. 63 FIG. 64

Simple Jig and Chuck for Drill Spindle.

slide is located in the right position to bring the tools in line with the casting holes by spring pin *B*, holes of course being drilled in the slide for each position. When the first hole in the casting is bored and tapped, simply pull the pin and shove the slide along until the pin drops into the next hole, and so on. When one side is finished pull the slide out, slip it in the other way and proceed as before.

These castings could have been handled in the same jig on a drill press with a proper chuck to facilitate rapid changing of tools, but we have no press in the department with sufficient power to drive a 2½-inch pipe tap. By the method used in getting out the piece before the building of this jig, work on the castings cost 24 cents for each. The operator had to do one hole in the whole batch and then the next hole in all of them, and so on, so that if the assemblers were in need of the castings they had to wait until the machine operator had the entire batch done, with the exception of the last hole. By the use of this jig one piece is finished before another is started and at a cost of 12 cents each. The jig cost about $5 to build.

Fig. 64 is a chuck for the drill press and adapted for use in connection with the above jig. There are modifications of this chuck on the market, but they don't seem to be as extensively used as they deserve to be. *C* is bored to fit the spindle of the drill press and is split so that it will clamp securely. *B* is bored to fit the shanks of the tools. *A* is cast flat on two sides to drive the tools, while *D* is a tool-steel pin which is held into a groove in the tool shank by the collar *T*, holding the tool from dropping out.

To put in the tool, simply raise the collar and shove the tool in, then let the collar drop, and your tool is in to stay. When the collar is raised again the tool drops out. The principal advantage of this chuck is that no wrench is needed, and in a majority of cases the tools can be changed without stopping the machine.

A SIMPLE DRILLING JIG

THE arrangement shown in Fig. 65 will be found a great help when getting out duplicate work in an ordinary drill press. A hollow arbor shown at *A* is fitted in the center of the table, and rings *B* are provided to fit any needed diameter; the circle of holes in templet *C*, which is clamped to the work *D* by the bolt passing

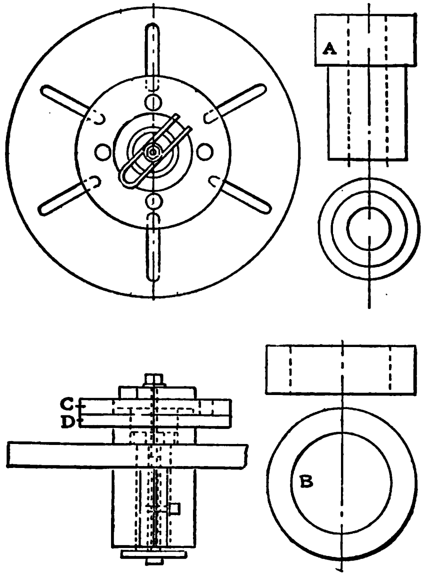


Fig. 65. — A Simple Drilling Jig.

down through the rig, can be kept in line under the drill by merely rotating the table.

A DRILL JIG FOR RAPID WORK

The sketch, Fig. 67, is of a drill jig, which has proved to be a very handy and efficient tool; the scheme, although not an original idea by any means, is very simple.

On the small piece shown in Fig. 66 it is required that the hole drilled by means of the jig shown in Fig. 67 be a certain distance from the shoulder on the piece, and that the hole be drilled

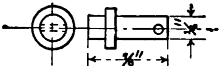


FIG. 66. The Work to be Drilled.

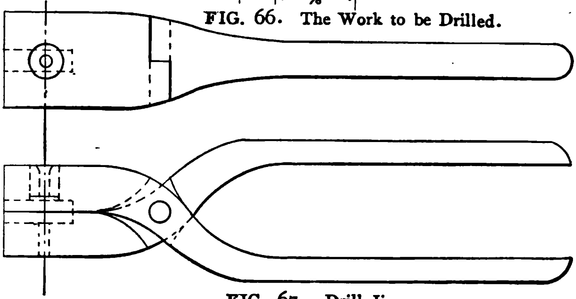


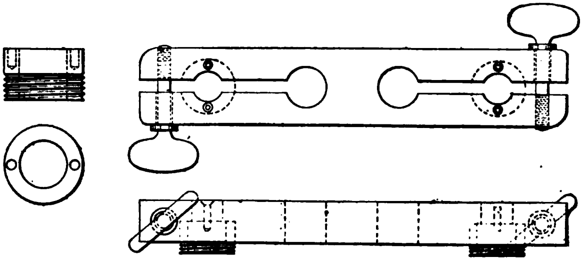
FIG. 67. Drill Jig.

A Quick Acting Jig.

in the center and straight; as there is an enormous quantity of these small pieces to turn out, this jig was devised. There may be a number of other tools that would insure as good and accurate a job as this jig, but for rapidity we know of none that can surpass this.

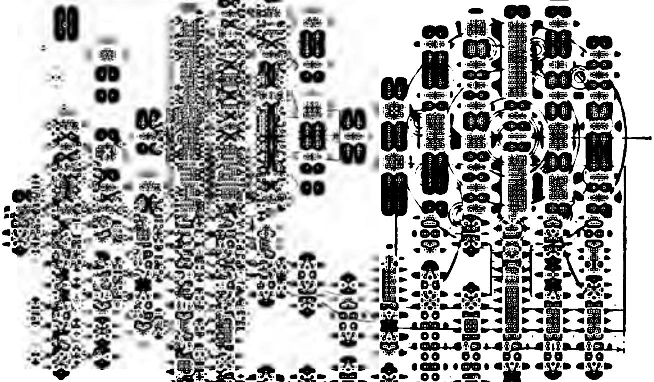
A SIMPLE JIG FOR DRILLING PIN WRENCH HOLES IN THREADED PLUGS

THE toolmaker was told to design a set of jigs for drilling holes in various sizes of screw plugs (like Fig. 68), which were used as spring retainers, and devised the style shown in Fig. 69, which were made of mild steel and case-hardened.



FIGS. 68 and 69. — A Simple Drill Jig.

Upon trial these jigs proved very satisfactory. It is obvious that the location of the holes will be alike in all of the plugs, owing to the fact that these are made from cold rolled bar stock, whose diameter, as is well known, seldom varies more than 0.002 or 0.003 inch, which could not possibly do any harm on this class of work, as the



which the work fits is hardened and ground, and on this same stud fits also the index plate and the upper bearing plate; the latter serving as a thrust bearing to take the downward pressure of the drill. The index plate is made of steel, and has eleven hardened and lapped bushings inserted into it; the periphery of the plate is nurled so that the operator can manipulate it with ease. A flat spring under the handle that operates the locking pin, and which is not shown in the print, serves to hold the pin always in position. The fixture has four feet which rest on the drill-press platen. Further explanation seems unnecessary, as the engraving is very clear.

AN INDEX JIG FOR GENERAL WORK

Fig. 71 shows a drill jig that can be used in a large variety of cases where holes are to be drilled in a circle or a portion of it. The index plate is shown at the center and can have any desired number of holes. The hardened bushing is in the end of the arm which is controlled or located by the index pin.

Arms of different length can be used if desired for various sized circles, or the same arm could have bushings at different distances from the center for this purpose. It will be found a very handy jig for many kinds of work.

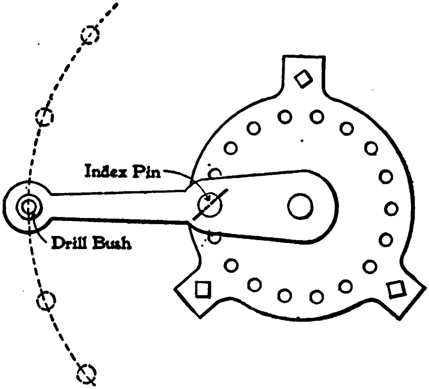


Fig. 71. — An Indexing Jig.

DRILLING FOR SET-SCREWS

Fig. 72 shows the jig used for drilling the bosses for the set-screws. After these holes are drilled they are tapped and the bosses faced for jam-nuts.

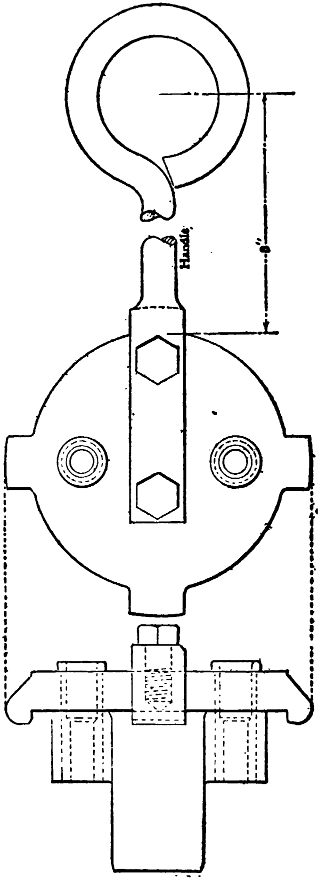


FIG. 72. — Jig for Drilling Set-screw Holes.

This drill work, as well as almost all other drill work, is done in one shop by using a separate drill press or drill spindle for each operation, the operator moving along from one press to the next as the operations are finished. We find this plan saves much time over the method of changing tools, feeds and speeds, and in some cases changing the hight of the table and drill-press head. Of course, when a certain jig is used for one hole only, or on one tool only, it might be best to finish all of this operation first and then proceed with the next operation in the same presses, but even this necessitates laying the pieces down on the pile and picking them up again, which takes considerable time in most cases.

DRILLING HOLES ON A HELICAL CASTING

FIG. 73 shows a drilling fixture, with the work in position, for drilling a 500 lot of malleable iron castings of the shape shown. In these castings it was necessary to drill twelve equally spaced holes *c c c* around the helical portion.

The design of the fixture and the manner in which it was used are shown clearly and can be understood by noting the way the work is supported under the helix, the shaft carrying the work, the index collar or cylinder with hardened bushings, the index pin and the drill bushing over the work.

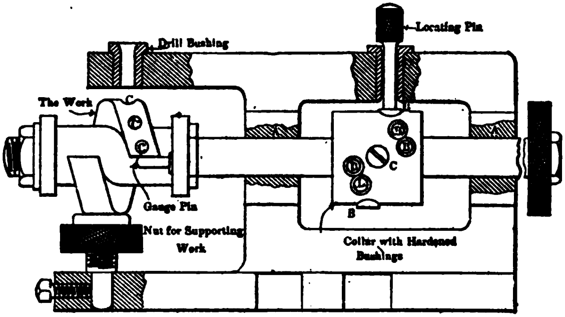


FIG. 73. — Drilling a Spiral.

SOME SMALL DRILL JIGS

THE accompanying sketches show three drilling fixtures which, while not mechanically new, present some interesting points in the manner of securing the work to be drilled.

Fig. 74 shows a copper strip and Fig. 75 the fixture, which is made from a straight piece of cast iron, grooved to take in the piece; the working point is at *A*, Fig. 74, as the ¼-inch hole must be an exact distance from the finished end.

The clamping screw *a* is the novel feature. It is made from a piece of flat steel ¼ x ½ inch, tapered and rounded at the back edge and fitted in an elongated slot which is also made taper at *b*. A slight turn of the nurled nut clamps the piece to be drilled. This makes a cheap and simple jig.

Figs. 76 and 77 show a small drill jig and the piece to be drilled. This piece is a casting machined first in the turret lathe; the center hole is drilled and reamed in the same machine. The object of the fixture is simply to drill the three 11/64-inch holes in the small bosses around the rim. The casting is slipped into the jig on the center pin *e;* the cover is then closed, leaving the screw *f* free until the casting is turned around, allowing the spring plunger pin *g* to locate itself in a corner of any one of the three small lugs, as at *h*, Fig. 77. The spring snap latch *i* holds

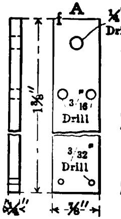


FIG. 74

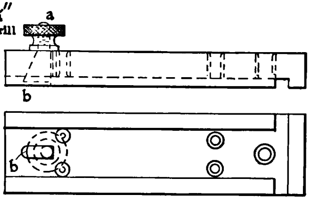


FIG. 75

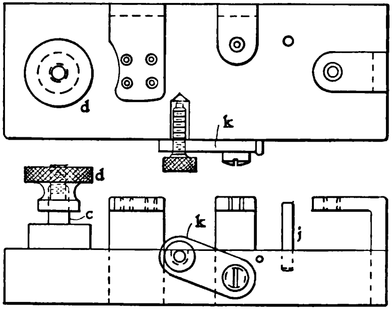


FIG. 78

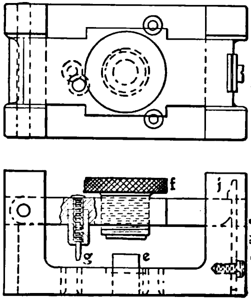


FIG. 76

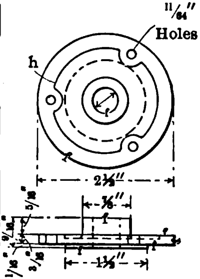


FIG. 77

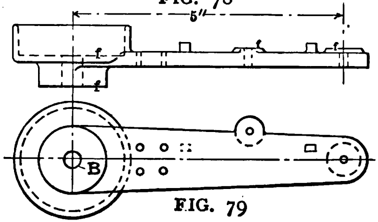


FIG. 79

Some Small Drill Jigs.

the cover, and the lock screw clamps the piece tight.

The fixture illustrated in Fig. 78 is designed for drilling the cast-brass lever shown in Fig. 79. The center hole is first drilled and reamed and the faces machined in the turret lathe.

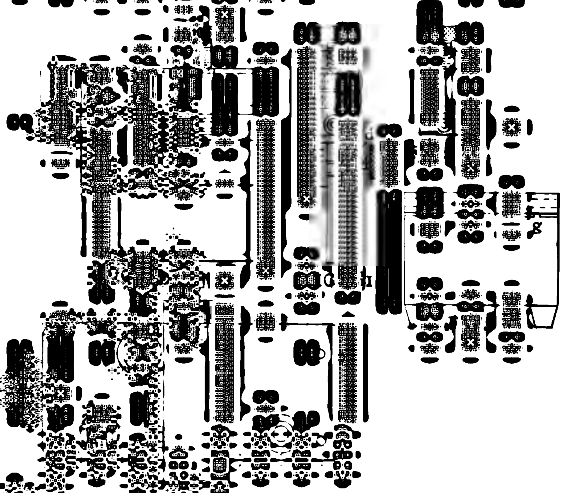
The jig is built up of a cast-iron plate with steel angle pieces attached, to hold the bushings. The casting is located in the fixture on a pin *c*, which also carries the clamp nut *d*, the swinging clamp *k* with its screw, locating and holding the casting firmly against the stop-pin *j*.

TWO SIMPLE HANDY JIGS

THE jigs shown in the accompanying sketches are in daily use in the tool room of the National Cash Register Company, and every toolmaker will appreciate their usefulness. The first, Figs. 80, 81, and 82, is for drilling the leaf of a jig preparatory to broaching for the taper pin upon which the hinge swivels. This jig is designed to drill a leaf ⅜ inch thick, although there are sizes for each thickness of leaf. The bar *a* is machined

[illegible]

[illegible] to [illegible] ch [illegible] ned



[illegible] lide [illegible] ond [illegible] ted [illegible] lace when adjusted by the nurl-head screw, the point of which seats in the slot (detail, Fig. 82).

The leaf is put in with the end against the pin *e* and the top against the bar, and is then clamped and squared up on an angle-plate and drilled in the drill press. It is then clamped in position on the jig, which has been previously machined as shown in Fig. 83, leaving the stock at *f* and *g* to hold the leaf away from the body of the jig for clearance. These points are afterwards removed.

A drill is now run half through from each side, and the parts, while still clamped, are broached for the pin.

We have all had our experience in swinging this same job upon the face-plate, carefully centering it and just as carefully running the drill through that it may not run off, etc. With this jig the chances of error are reduced to the minimum, besides a great deal of valuable time is saved.

The second jig, Fig. 84, is for drilling milling-machine vise jaws, and of this there are also sizes for each size of vise. The body is a forging with an ear on one end through which the screw that binds the jaw passes. The center is dovetailed to receive the slide which forms the adjustment for the different widths of jaws, and is bound when so adjusted by the ring and screw. The jaw is put in the jig against the pins, the binding screws are tightened and the whole is then placed on the drill, the jig on top and the jaw flat on the table and drilled.

We have worked in tool rooms where a milling-machine vise jaw job was almost as bad as a sentence of ten days in jail, for we had to carry around an angle plate weighing, perhaps, 75 pounds, to square the vise up on to spot the holes, the vise weighing perhaps as much more, besides using a lot of spotting drills which were generally in a sorry state of dilapidation. By this method it is not always necessary to handle even the vise.

V-BLOCK FITTED AS AN ADJUSTABLE DRILL JIG

THE accompanying sketch, Fig. 85, shows a V-block fitted up as an adjustable drill jig, for drilling holes central in various sizes of round stock. The square spindle *B* is turned tapering at one end, and driven in block *A*, through which it extends into a counterbored hole, admitting of easy removal (with the aid of lead hammer) so that the V-block may be used for other purposes. One side of this spindle comes in contact with a lug *C*, thereby locating the drill arm *E*, in which various size slip bushings are used, central with the V in the block.

The spindle *B* has a groove cut lengthwise on one side, forming a seat for the point of screw *F*. The arm *H*, clamped by a filister head screw when swiveled to the left in connection with the rod as shown and held by a set-screw, acts as a gage when drilling work a certain distance from the end. The gage rod *G* is long enough to reach the center of the bushing.

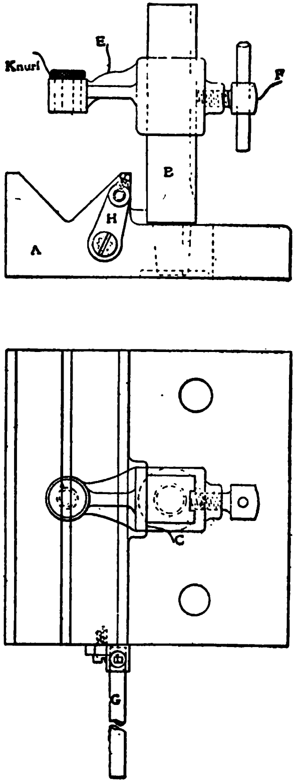
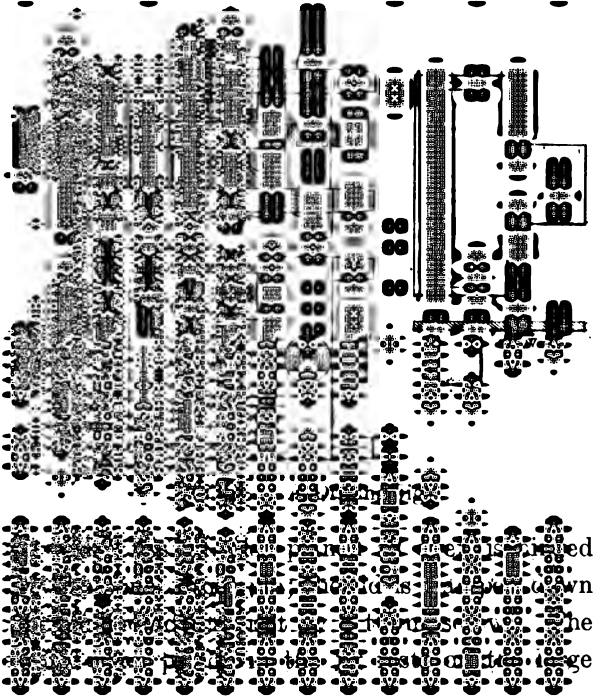


FIG. 85. — V-Block Fitted as Adjustable Drill Jig.

[illegible]

[illegible]



[illegible]

[illegible]

hardened stud *b* and the two smaller ones *c c*, which also act as locating stops. The lid being closed, the work is brought forward until it just touches the stops *c c* by means of the screw *d*. The screw *e* is now run forward. The point enters the opening between the fingers *f f*, forcing them apart, and these, acting on the casting at *g g*, locate it sideways. The screw *h* is tightened and the binding screws all gone over to make sure the work is against the stops. The drilling is performed on a multiple-spindle drill.

HARDENING DRILL-JIG BUSHINGS

To harden drill-jig and reamer bushings to prevent shrinkage: Heat the bushing evenly in a slow fire to a fair hardening temperature, withdraw from fire and rub or sprinkle cyanide of potassium all over the piece, reheat as before and then plunge it into a bath of warm oil, and do not withdraw until the piece has reached the same temperature as the oil. The bushing will be hard, and does not require drawing, owing to its great toughness. Rub all over with a file card or stiff wire brush to clean the piece. After a close examination, the operator will find the bushing has not changed its shape or size, as would surely be the case were it hardened in water. Care should be taken to catch the piece with a very small pair of tongs around the outside. A poker should never be placed through the hole while dipping. This is a very simple operation, and one that should be practised in every factory where jigs are made, yet how many mechanics are, even to-day, wasting valuable time lapping jig bushings after they are hardened! Just a little shop leak, but easily remedied.

INDEX

PAGE
Amateur's drill press ... 47
Automatic water valve ... 21

Ball-handle drilling jig ... 65
Balls, jig for drilling ... 71
Boring large holes in a small press ... 31
Broaching and drilling at once ... 52
Bushings, hardening without warping ... 98

Carburetor, making in a drill press ... 35
Center block with V ... 25
Chuck for drill spindle ... 76
Chucking work on a drill press ... 33
Clamping work for drilling ... 56
Collet ejector ... 30
Combination tool for drill press ... 14
Cutter for facing ... 10
Cutting oil grooves in drill press ... 12

Drill for deep spindle drilling ... 6
  holder ... 3
  press for amateurs ... 47
  with stepped cutting edge ... 5
Drill, extension, easy way to make ... 2
  for cutting air ... 1

PAGE

Drilling a slotted hole 49
  and broaching at once 52
  ball handles 65
  flat strips 62
  helical casting 87
  into an open side 1
  jig for set-screws 85
  pin wrench holes 82
  small hole for a leader 49
  tool steel 10

Extension drills, easy way to make 2

Facing cutter for drill press 10
Finishing drill, half round 5
Foot feed for drill 25

General indexing jig 84
Grinding drills for cutting air 1

Half-round finishing drill 5
Hand-rail pillars, jig for 73
Hardening drill-jig bushings 98
Helical casting drill jig 87
Holder for drills 3

Index for general drilling work 84
Indexing drill jig 83

Jig bushing, how to harden 98
  for drill spindle 76
  drilling ball handles 65

PAGE

Jig drilling collars........ 61
  drilling helical casting 87
  drilling leaf 91
  drilling set-screw holes 85
  hand-rail pillars 73
  indexing 83
  made of a V-block 95
  pin wrench holes 82
  two-spindle drill 75
  with hinged cover 97
Jigs for small work 88

Large holes in a small drill press 31
Lathe work in a drill press 35
Leader hole ahead of main drill 49
Leaf-drilling jig 91

Novel collet ejector 30
Nut tapping in drill press 28

Oblong holes 50
Oil groove cutting in drill press 12
One-sided drilling 1

Plier drilling jig 80

Rapid work drilling jig 80
Reaming and turning tool........ 14

Sensitive drill attachment 19
Set-screw drilling jig 85
Simple drilling jig 79

PAGE

Slotted hole drilling 49
Small drill jigs 88
Spindle drill 6
Stepped cutting edge for drill 5
Straps without blocking 55

Tapping ball handles 68
  large work without a tap 18
  nuts in drill press 28
Tong drilling jig 80
Tool for reaming and turning 14
  for turning bosses 16
  steel, the way to drill 10
Tools used in making a carburetor 35
Turning bosses in the drill press 16
Two-spindle drill-press jig 75

V-block drilling jig 95
V-center block 35

Water valve for multiple-spindle drill 21

HAVE YOU THESE?

Practical Planer Kinks. By Carroll Ashley. 80 pages, 5 x 8, 34 illustrations. $1.00 postpaid.

Dimensions and Weights of Pipe and Fittings. 11 x 8. $.50 postpaid.

The Electrical Catechism. Compiled by the *Power* editors from *Power*. 5¾ x 7⅞, 246 illustrations. $2.00 postpaid.

Manufacture and Properties of Iron and Steel. By Harry Huse Campbell. Entirely revised in 1907, 641 pages, 6 x 9, cloth. $5.00 postpaid.

Precision Grinding. By H. Darbyshire. 6 x 9, cloth, fully illustrated. $2.00 postpaid.

Steam Turbines. By Lester G. French. 340 pages, 6 x 9, cloth, fully illustrated. $3.00 postpaid.

Engine Room Chemistry. By Prof. Augustus H. Gill of the Massachusetts Institute of Technology. 4½ x 6½, fully illustrated. $1.00 postpaid.

Eminent Engineers. By Dwight Goddard. 280 pages, 5 x 8. $1.50 postpaid.

Combustion and Smokeless Furnaces. By Joseph W. Hays. 112 pages, 6 x 9, illustrated. $1.50 postpaid.

The Compound Engine. By F. R. Low, editor of *Power*. 48 pages, 6 x 9, 37 illustrations. $.50 postpaid.

Condensers. By F. R. Low, editor of *Power*. 80 pages, 6 x 9, 23 illustrations. $.50 postpaid.

The Steam Engine Indicator. By F. R. Low, editor of *Power*. 208 pages, 6 x 9, illustrated. $1.50 postpaid.

Questions and Answers from the American Machinist. Compiled by Frank Richards. 420 pages, 5 x 7. $1.50 postpaid.

Chordal's Letters. By James W. See. 396 pages, 5 x 8, 32 illustrations. $2.00 postpaid.

The Design and Construction of Cams. By C. F. Smith, F. A. Halsey, and others. 70 pages, 9 x 12, fully illustrated. $3.00 postpaid.

Things that Are Usually Wrong. By Prof. John E. Sweet. 52 pages, 5 x 8, 50 illustrations. $.50 postpaid.

Grinding and Lapping. Tools, Processes and Fixtures. By Joseph V. Woodworth. Author of "*Dies,*" "*Punches, Dies and Tools,*" "*American Tool-Making and Interchangeable Parts,*" etc., etc. 200 pages, 6 x 9, fully illustrated. $2.00 postpaid.

HILL PUBLISHING CO.

505 Pearl Street, - - New York
6 Bouverie Street, - - London, E. C.

The Engineering and Mining Journal, Power,
American Machinist

89089665509

B89089665509A

N DAYS

. A fine of TWO CENTS will be charged for each day the book is kept over time.

Colvin & Stanley

TDN
.C72

Drill Press Kinks.